KONGUNADU ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

COIMBATORE – 641 029

DEPARTMENT OF BIOTECHNOLOGY (PG)

CURRICULUM AND SCHEME OF EXAMINATIONS (CBCS)

(2019 - 2020 and onwards)

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

Coimbatore – 641029

Vision

Developing the total personality of every student in a holistic way by adhering to the principles of Swami Vivekananda and Mahatma Gandhi.

Mission

- Imparting holistic and man-making education with emphasis on character, culture and value - moral and ethical.
- Designing the curriculum and offering courses that transform its students into value added skilled human resources.
- Constantly updating academic and management practices towards total quality management and promotion of quality in all spheres.
- Extending the best student support services by making them comprehensive and by evolving a curriculum relevant to student community and society at large.
- Taking steps to make education affordable and accessible by extending scholarships to the meritorious and economically disadvantaged students.
- Moulding the teachers in such a way that they become the role models in promoting Higher Education

DEPARTMENT OF BIOTECHNOLOGY

Vision

- To nurture world-class bioengineers with a potential to innovate, invent and disseminate knowledge for the benefit of society and environment.
- To develop the candidate with zeal towards Life Sciences with the spirit of moral, ethics, life and character building required for future Good Human being, a Genuine Scientist, a Hardworking Person, as Entrepreneur and as Bread Earner.
- To produce competent Biotechnologist's who can employ premium processes and applications which will profoundly influence the existing paradigm of agriculture, industry, healthcare and restoration of environment providing sustainable competitive edge to present society.

Mission

- The Department of Biotechnology of Kongunadu Arts and Science College, a family of Enthusiastic students, Committed teachers and Independent thinkers working and learning together to shape the future.
- We focus on implementing the valued education in the Life Sciences to bring about a new revolution in the field of Biotechnology.
- We encourage and comfort the candidate with the passion to undergo in the future to take the alleyway of education and research to serve the World with new energy of knowledge and beneficial products as life saver.

M.Sc. BIOTECHNOLOGY

PROGRAMME OUTCOME (PO)

PO1: Explain and properly apply the scientific method by developing valid hypotheses, designing experiments, gathering relevant data using current technology.

PO2: To enable understandingof emerging and advanced concept in modern biology and help students to take up their carrier in this field.

PO3: Acquire in depth knowledge on the basic concepts of biology of living cellsincluding structural, morphological and physiological features and functions.

PO4: Apply the fundamentals of molecular biology theories, and techniques by critically analyzing and interpreting a recent and relevant scientific research paper that has been published in a refereed scientific journal.

PO5: Impart a clear vision on the minds about health and environmental crisis and their associated problems.

PO6: To impart a keen knowledge on economically important biomolecules and application of different cell culture system for better and improved production.

PO7: Encourage the desired interest of students to gain knowledge on latest allied fields with theatrical and technical skills to compete in the growing Biotechnological world.

PO8: The student will be able to get familiarized with professional and economic issues in Biotechnology and foster impart job related skills such as communications and experience in working as a team that will help them to become good Entrepreneurs.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1 : Apply knowledge of applied science and research fundamentals in the area of biotechnology – cell and molecular biology, microbial technology, genomics, proteomics, genetic engineering, advanced plant and animal sciences, computational biology, etc.

PSO2 : Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PSO3 : Understand the impact of the biological solutions / needs in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. Apply ethical principles and commit to professional ethics and responsibilities and norms of the current practice.

PSO4 : Demonstrate knowledge and understanding of concepts, principles and experimental approaches in Biotechnological to one's own work, as a member and leader in a team. Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PSO5 : Demonstrate an ability to identify careers in biotechnology, domain like Pharmaceutical, Food Industry etc, and skills required to work in a biotechnology laboratory or manufacturing facility.

PBT01

KONGUNADU ARTS AND SCIENCE COLLEGE (Autonomous)

COIMBATORE-641 029.

M.Sc. BIOTECHNOLOGY

Curriculum & Scheme of Examination under CBCS

(Applicable to Students Admitted from the Academic Year 2019-2020 and onwards)

Semester	Subject Code	Title of the Paper	Instruction Hours / cycle	Exam. Marks			Duration of Exam. Hrs.	Credits
				CIA	ESE	Total		
I	19PBT101	C.P.1 – Biochemistry	5	25	75	100	3	5
	19PBT102	C.P.2 – Biostatistics and Bioinstrumentation	5	25	75	100	3	5
	19PBT103	C.P.3 - Cell Biology and Molecular Genetics	5	25	75	100	3	5
	19PBT104	C.P.4 – Microbiology	5	25	75	100	3	5
	19PBT1CL	C.Pr.1- Lab in Biochemistry, Biostatistics and Bioinstrumentation	5	40	60	100	6	3
	19PBT1CM	C.Pr.2- Lab in Molecular Genetics and Microbiology	5	40	60	100	6	3
		Total	**30**	**-**	**-**	**600**	**-**	**26**
II	19PBT205	C.P.5 – Genetic Engineering	5	25	75	100	3	4
	19PBT206	C.P.6 – Immunotechnology	5	25	75	100	3	4
	19PBT207	C.P.7 - Animal Biotechnology	5	25	75	100	3	4
	19PBT208	C.P.8 - Environmental Biotechnology and Bionanotechnology	5	25	75	100	3	4
	19PBT2CN	C.Pr.3 - Lab in Molecular Biology and Genetic Engineering	5	40	60	100	6	3
	19PBT2CO	C.Pr.4 - Lab in Immunotechnology, Animal Biotechnology and Environmental Biotechnology	5	40	60	100	6	3
		Total	**30**	**-**	**-**	**600**	**-**	**22**
III	19PBT309	C.P.9 – FermentationTechnology	5	25	75	100	3	5
	19PBT310	C.P.10 - Plant Biotechnology	5	25	75	100	3	5
	19PBT411	C.P.11 - Genomics, Proteomics and Computational Biology	5	25	75	100	3	5
	19PBT1E1	Major Elective I	5	25	75	100	3	5
	19PBT3CP	C.Pr.5 -Lab in Fermentation Technology, Plant Biotechnology and Computational Biology	5	40	60	100	6	3
	19PBT3N1	Non-Major Elective I – (On-line)	5	25	75	100	3	5
	19PBT3ST	Summer Training @	-	-	-	-	-	-
		Total	**30**	**165**	**435**	**600**	**-**	**27**
IV	19PBT3E2	Major Elective II	5	25	75	100	3	5
	19PBT4N2	Non-Major Elective II - (On-line)	5	25	75	100	3	5
	19PBT4Z1	Project Work *	20	40	160*	200	3	5
		Total	**30**	**90**	**310**	**400**	**-**	**15**
			120	-	-	2200	-	90

Note: CBCS – Choice Based Credit System; CIA – Continuous Internal Assessment;
ESE – End of Semester Examinations; C.P. - Core Paper; C. Pr. – Core Practical

***** Project Report – 140 marks; Viva-voce – 20 marks; Internal – 40 marks

@ The students shall undergo an Internship training/field work for a minimum period of 3 weeks at the end of the fourth semester during summer vacation and submit the report in the fifth semester. The report will be evaluated for 100 marks along with the internal viva voce by the faculty members and HoD. According to their marks, the grades will be awarded as given below.

Marks %	Grade
85-100	O
70-84	D
60-69	A
50-59	B
40-49	C
<40	U (Reappear)

Major Elective Papers *(2 papers are to be chosen from the following 4 papers)*

1. Pharmaceutical Biotechnology
2. Bioethics, Biosafety, IPR and Total Quality Management
3. Natural Products
4. Bioentrepreneurship, Marine and algal biotechnology

Non-Major Elective Papers *(2 papers are to be chosen from the following 2 papers)*

1. Competitive Science – I
2. Competitive Science - II
3. Food Technology
4. Cancer Biology

Tally Table:

Part	Subject	No. of Subjects	Total Marks	Credits
I	Core – Theory / Practical / Project	18	1800	70
	Major Elective Paper	2	200	10
	Non Major Elective Paper	2	200	10
	Grand Total	**22**	**2200**	**90**

Advanced Learner's Course (ALC) under self-study scheme (optional)

Subject Code	Title of the Paper	Exam Marks		Duration of Exam (hours)	Credits
		ESE	Total		
19PBTD1	ALC.1- Frontier Technologies in Biosciences	100	100	3	2
19PBTD2	ALC.2- Stem Cell Technology	100	100	3	2

- 25 % CIA is applicable to all theory subjects. Proportion of CIA and ESE for practical is 40: 60.
- JOCs are optional for earning extra credits and are conducted 4 hours / cycle after college hours.

Job Oriented Courses (JOC):

1. JOC 1 – Plant Tissue Culture and Organic Farming (19PBTJ1)
2. JOC 2 – Herbal Biotechnology (19PBTJ2)

Note: JOC and ALC which are offered at present will be applicable for the students admitted during the academic year 2019-2020 and will be considered as extra credit courses.

- 25 % CIA is applicable to all subjects except JOC, COP and SWAYAM courses which are considered as extra credit courses.
- The students are advised to complete a SWAYAM-MOOC before the completion of the 3rd semester and the course completed certificate should be submitted to the HOD. Two credits will be given to the candidates who have successfully completed.
- A Field Trip preferably relevant to the course should be undertaken every year.

Components of Continuous Internal Assessment

Components		Marks	Total
Theory CIA 1	75	(75+75 = 150/10) 15	25
CIA 2	75		
Assignment/ Demonstration/Seminar		5	
Attendance		5	
Practical CIA Practical		25	40
Observation Notebook		10	
Attendance		5	
Project Review		15+15	40
Regularity		5+5	

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remember; **K2**-Understanding; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate

1. Theory Examination - Part I, II & III

(i) CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	75
K2 Q11 to 15	B (Either or pattern)	5 x 5 = 25	Short Answers	
K3 & K4 Q16 to 20	C (Either or pattern)	5 x 8 = 40	Descriptive / Detailed	

(ii) CIA I & II and ESE: 55 Marks

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	55
K2 Q11 to 15	B (Either or pattern)	5 x 3 = 15	Short Answers	
K3 & K4 Q16 to 20	C (Either or pattern)	5 x 6 = 30	Descriptive / Detailed	

2. Practical Examination:

Knowledge Level	Section	Marks	Total
K3	Experiments	50	60
K4	Record Work	10	
K5			

3. Project Viva Voce:

Knowledge Level	Section	Marks	Total
K3	Project Report	160	160
K4	Viva voce	20	
K5			

19PBT101

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT101		C.P.1 – Biochemistry		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. On the successful completion of the subject, the student get an overall understanding of structure of atoms, molecules and chemical bonds
2. Gains knowledge on enzyme kinetics
3. Understands biopolymers and metabolic reaction in the living systems.

Course Outcomes (CO)

K1	CO1	Defining the terms Water and buffers
K2	CO2	Classifying and summarize Carbohydrates, proteins, amino acids and lipids structure and properties
K3	CO3	Applying the concept of Enzyme
K4	CO4	Distinguishing the different types of Vitamins

Syllabus

UNIT I (15 Hours)

Structure of atoms, molecules and chemical bonds, Covalent and Noncovalent interactions - Van der Waals, Electrostatic, Hydrogen bonding and hydrophobic interactions; Respiration and photosynthesis. Energy metabolism (concept of free energy); Principles of thermodynamics; Kinetics, dissociation and association constants; bioenergetics.

UNIT II (15 Hours)

Carbohydrates: Definition, classification, purifications, properties and biological importance, Mono-, di- and tri- saccharides, Polysaccharides and mucopolysaccharides of biological importance. Methods for compositional analysis. Blood group substances glycoproteins & peptidoglycans. Glycolytic Pathway, TCA Cycle, Oxidative Phosphorylation, Electron Transport Chain, **Gluconeogenesis***, HMP shunt.

UNIT III (15 Hours)

Proteins: Amino acids and peptides-classification, chemical reactions and physical properties. Peptide bond - stability & formation. Proteins - physico-chemical properties, structure [primary, secondary, tertiary and quaternary]. Purification and criteria of homogeneity: protein folding-

biophysical and cellular aspects. Amino acid catabolism (Transamination, deamination and decarboxylation)

UNIT IV (15 Hours)

Lipids: Definition and classification of lipids, Structure, classification and properties of fatty acids, Steroids- Structure and functions of cholesterol. B - Oxidation of fatty acids. Fatty acid biosynthesis.

Nucleic acids: Component, Structure and Different forms of DNA and RNA. Nucleotide metabolism and its regulation.

UNIT V (15 Hours)

Biochemistry of Small Molecules: Physiological function of vitamins (Vitamin A & C), hormones (Insulin).

Enzymes: Basic concept, Enzyme Classification, active site, specificity, kinetics (Negative and positive co-operativity) inhibitors (reversible and irreversible), isoenzymes, allosteric enzymes, co-enzymes (NAD), Ribozyme, hammer head, hair pin and other ribozymes, strategies for designing ribozymes. Abzyme: structure and drug targets (enzymes and receptors).

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Textbook

1. Michael.M.Cox., David.L.Nelson, (2011), Leninger Principles of Biochemistry, W.H. Freeman and Company.
2. Jain, J.L., Sunjay Jain, Nithin Jain, (2009), Fundamentals of Biochemistry, S. Chand and Company, Ltd.

Reference Books

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Trevor Palmer, Published by Horwood Publishing Limited, 2001, Edition: 5.
2. Biochemistry, Donald Voet, Judith G. Voet, Published by J. Wiley & Sons, 2010, Edition: 4.
3. Harper's Illustrated Biochemistry, Robert K. Murray, Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Published by McGraw-Hill Professional, 2012, Edition: 29.
4. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry-Trevor Palmer, Published by Horwood Publishing Limited, 2001, Edition: 5.
5. Teitz text book of clinical biochemistry 3rd edition – Burtis et al., William Heinmann medical books, Ltd., 1999

19PBT101

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	H	M	M	M
CO2	H	M	H	H	M
CO3	M	H	M	M	M
CO4	H	M	H	M	M

S – Strong **H** – High **M** – Medium **L** – Low

19PBT102

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT102		C.P.2 – Biostatistics and Bioinstrumentation		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To make the student to understand the methods and tools in biostatistics
2. To obtain knowledge on working principles of different instruments
3. To learn the usage of instruments in experiments for future research

Course Outcomes (CO)

K1	CO1	To recollect the concepts of biostatistics and bioinstrumentation
K2	CO2	To understand the formula and principles used in biology
K3	CO3	To apply different data used in biological samples
K4	CO4	To analyse the importance about instruments in biological laboratory

Syllabus

UNIT I (15 Hours)

Biostatistics –Scope of Biostatistics Measures of Central tendency: Arithmetic Mean, Median and Mode Measures of dispersion: Absolute and relative measures. Mean deviation, standard deviation and variance. Graphical and diagrammatic representations (Scale diagram, line diagram, Histogram), Theory of errors, measure of precision, Probable errors of function, rejection of observation, Correlation: Definition, rank correlation and Karl Pearson's coefficient of correlation. Regression: definition, regression of Y on X and X on Y.

UNIT II (15 Hours)

Testing of Hypothesis: Student's t test. Chi-square test and its applications. ANOVA and its significance (theory). Designing of experiments and statistical analysis. Use of software for statistical analysis (SPSS,'R')

UNIT III (15 Hours)

: Types of centrifuges, Principles and applications of analytical and preparative centrifuge, density gradient and ultra-centrifuge. Photometry: Beer Lambert's law, Extinction coefficient, Principles and application of UV-VIS, ~~Mass~~, FTIR and NMR spectrophotometry, Flourimetry and flame photometry – working and applications.

19PBT102

UNIT IV (15 Hours)

ELISA reader: Working and applications. Microscopy: Phase contrast microscope, SEM and TEM-instrumentation and applications in biology. Chromatography: Principle and types - ion exchange, ~~G~~ ~~HPLC~~, Gel Filtration, High-performance liquid chromatography, High-performance liquid chromatography ~~HPTLC~~, and Gas Liquid Chromatography. Lyophilizer, **Sonication*** and X-ray crystallography.

UNIT V (15 Hours)

Electrophoresis: Principle, factors affecting electrophoresis, AGE*, PAGE, Native PAGE, 2 D-Gel electrophoresis - principle, instrumentation and Applications, isoelectric focusing, Recent advances in capillary electrophoresis, Mass spectrometry - Instrumentation, methodology and applications. **G**el **i**mage **s**ystem - instrumentation and applications. PCR: Principle, types, instrumentation and applications, Nanopore sequencing.

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. Boyer, R., (2000), Modern Experimental Biochemistry, III Edition, Addison Wesley Longman, New Delhi.
2. Wilson, K. and J. Walker., (2000), Practical Biochemistry, 5th edition, Cambridge University Press, Cambridge.
3. Pillai R. S. N. and Bhagavathi V., (2000), Statistics, Sultan Chand & Co., New Delhi.
4. Gupta, S.P., 2001. Statistical Methods, Sultan Chand & Co, New Delhi.

Reference Books

1. Sundar Rao, P.S.S., and J. Richard, (2006), Introduction to Biostatistics and Research methods, PHI Publication, New Delhi.
2. Holme and Peck., (1998), Analytical Biochemistry, 3rd Edition, Longman Scientific.
3. Skoog and Leary., (1992), Principles of Instrumental analysis, 4th Ed. Saunder's College publishing, New York.

19PBT102

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	S	H	S
CO2	H	M	H	H	M
CO3	M	S	M	M	M
CO4	M	H	M	M	M

S – Strong **H** – High **M** – Medium **L** – Low

19PBT103

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT103		C.P.3 – Cell Biology and Molecular Genetics		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

- To understand and apply the principles and techniques of molecular biology
- To make the students to understand the concept of gene, modulation of gene its regulation, modes of transmission and defects
- To teach the advanced knowledge in a specialized field of molecular and cell biology

Course Outcomes (CO)

K1	CO1	Recalling the principles and basic mechanisms of metabolic control and molecular signaling
K2	CO2	Extending the knowledge and understanding of the molecular machinery of living cells
K3	CO3	Applying the knowledge gained through the understanding of Molecular Screening for disease diagnosis
K4	CO4	Analyzing the causes, genetics and recent treatment strategies of cancer

Syllabus

UNIT I (15 Hours)

Cell Transport: Passive transport - Osmosis, Diffusion, Active transport-Na^+, K^+ pump. Cell signaling: Juxtacrine, Paracrine and Endocrine Signaling-Neurotransmitters & Hormones. G Protein Coupled receptors, their secondary messengers and signal transduction pathway. Cell Signaling pathways that control gene activity-Notch signaling; TGF-Beta and activation of Smads, Jak-STAT pathway.

UNIT II (15 Hours)

Extracellular matrix components, Cell-cell interactions and cell matrix interactions, Cell differentiation: hormones and growth factors, Apoptotic pathways, Cell cycle Control mechanisms: Role of cyclins and Cdks, Cell cycle check points, Molecular events in *S. cerevisiae.* Transposons and insertion sequences, Prokaryotic and Eukaryotic Transposons.

19PBT103

UNIT III (15 Hours)

Replication: DNA (prokaryotes and eukaryotes) and RNA replication – mechanism and enzymology. Gene expression: Transcription, RNA processing, Translation, Posttranslational modifications, Intracellular protein transport, Protein turnover and degradation.

UNIT IV (15 Hours)

Chromatin structure and remodeling in relation to gene expression, DNase hypersensitivity, DNA methylation. Control of gene expression in prokaryotes and eukaryotes: operon model- trp operon, gene battery model (eukaryotes), Lytic cascades and lysogenic repression in lambda. Molecular biology of Cancer: Causes and Genetics of cancer, Tumor suppressor genes and oncogenes (p53 and pRB).

UNIT V (15 Hours)

Inherited disorders - Autosomal and allosomal-molecular and cytogenetics, Teratology, Molecular Screening– Haematological malignancies, Cancer; Pharmacogenetics (Her2 and breast cancer), *Population Genetics* - Hardy-Weinberg principle, Quantitative genetics and multifactorial interactions, causes of variation and artificial selection, **genetic load and genetic counseling***. Genotoxicity and detection assays.

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. Peter J Russell. (2009). iGenetics: A Molecular Approach (3rd Edition), Benjamin Cummings publication.
2. Lodish, D., Berk, A., Chris A. Kaiser. (2007). Molecular Cell Biology, 6th edition, Scientific American Books, Inc

References

1. Lewin. (2009). Genes X. Oxford University Press, U.K.
2. Hartl, DL. (2000). A Primer of Population Genetics. 3rd Edition, Sinauer Associates Inc., Sunderland.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (2007). Molecular Cell Biology, 5th Edition. Garland Publishing, Inc, NY.
4. Cooper, GM. (2009). The Cell - A Molecular Approach.5th edition. ASM and Sinauer Press, Washington.
5. Strachan, T., Read, A. (2010). Human Molecular Genetics. 4th edition, Garland Science.

19PBT103

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	M	M
CO2	M	H	S	H	H
CO3	H	S	M	S	S
CO4	S	M	S	M	H

S – Strong **H** – High **M** – Medium **L** – Low

19PBT104

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT104		C.P.4 – Microbiology		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

- To make the students to understand the basic concepts of the biology of microorganisms and its mechanism of action in host cells.
- To learn the microbiological techniques used for the classification of microorganisms
- To understand the microbe-host interaction and their metabolic activities

Course Outcomes (CO)

K1	CO1	Recollecting the early development and physiology of microbes
K2	CO2	Understanding the microbial taxonomy and classification methods.
K3	CO3	Applying the knowledge of microbiological methods to study about the microbes by phenotypic and genotypic methods
K4	CO4	Applying the knowledge to learn about the food spoilage due to cause of microbial contamination and food preservation methods

Syllabus

UNIT I (15 Hours)

History of microbiology- Development of microbiology in 20^{th} century. Morphology, ultra structure of bacteria. General characters of Fungi, Algae and Protozoa. Virus: Discovery, structure and classification – Baltimore cultivation of viruses – detection and enumeration, viral assays.

UNIT II (15 Hours)

Microbial taxonomy – classification systems– Molecular systematics: Polyphasic approach –16S/18S rRNA gene sequencing, Phylogenetic grouping. Mol % G+C analysis, DNA-DNA hybridization, Fatty Acid Methyl Ester (FAME) analysis. Principles and nutritional requirements for the growth of bacteria - culture media and types. Sterilization - principles and applications of physical and chemical methods. Methods of staining - bacteria and fungi.

UNIT III (15 Hours)

Soil Microbiology: Microbial flora of soil – bacteria, fungi, algae and protozoa. Microbial interactions among soil microorganisms - microbial populations and with plants (N_2 fixation) - **Biogeochemical cycles (C, N, P and S cycles)*.** Plant growth promoting bacteria (*Azospirillum lipoferum, Bacillus licheniformis, Pseudomonas fluorescens, Streptomyces lydicus and Rhizobia. leguminosarum*).

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19PBT104

UNIT IV (15 Hours)

Principles of food preservation - High temperature, low temperature, drying, radiation, Canning and packaging; Contamination and spoilage of meat, fish, milk, egg, vegetables and fruits. - **Food quality and control*.** Preservation and maintenance of microbes, Probiotics and Bacteriocins.

UNIT V (15 Hours)

Medical Microbiology: Host parasite relationship, epidemiology, pathogenesis, prevention and treatment - *Staphylococcus, Streptococcus, Mycoplasma, Aspergillosis, Salmonella, Clostridium, Rubella, Rabies, HPV, HBV and HCV*.

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. Willey, J., L. Sherwood, C. Woolverton, 2013, Prescott's Microbiology, 9th Edition. McGraw-Hill Higher Education.
2. Pelczar, M. J. JR. *et al*. Microbiology: Concepts and Applications. Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 1993.

References

1. Stainer *et al*., 1992. General Microbiology, 5th edition. Macmillan Education Ltd., London.
2. Tortora, G.J. *et al*., 1995. Microbiology - An Introduction, 5th edition. The Benjamin/Cummings Publishing Co. Inc., USA.
3. Frazier, W. C. and D. C. Westhoff. 2003. Food Microbiology. 4th Edition. Tata McGraw-Hill Publishing Co. Pvt. Ltd., New York.
4. Ananthanarayan and Paniker, 2013. Textbook of Microbiology Ed. Arti Kapil Orient Black Swan; 9th edition.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	M	M
CO2	M	H	S	H	H
CO3	H	S	M	S	S
CO4	S	M	S	M	H

S – Strong **H** – High **M** – Medium **L** – Low

19PBT1CL

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT1CL		C.Pr.1- Lab in Biochemistry, Biostatistics and Bioinstrumentation		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 3

Course Objectives

- To get hands on experience and to learn the principles behind Biochemistry, Biostatistics and Bioinstrumentation techniques.
- To give experience in working principle of Instruments
- To train the students on SPSS software, ANOVA, Regression, Correlation and Standard deviation.

Course Outcomes (CO)

K3	CO1	Extending the hands on experience on standard solution preparation, quantitative analysis of compounds
K4	CO2	Developing and applying the skills gained through the instrumentation
K5	CO3	Examining and to analyze the results behind the Excel, SPSS software.

Syllabus

I- BIOCHEMISTRY

1. Estimation of total sugars by Anthrone method.
2. Estimation of protein by Lowry's method.
3. Estimation of Phosphorus by Fiske Subbarrow method.
4. Estimation of cholesterol by modified Zak's method.
5. Estimation of total phenolics and flavonoids.
6. Estimation of Urea by DAM-TSE method.
7. Enzymes

   Preparation of crude enzyme extract.

   a. Effect of pH on the activity of catalase.
   b. Effect of temperature on the activity of catalase.
   c. Effect of enzyme concentration on the activity of catalase.
   d. Effect of substrate concentration on the activity of catalase.
8. Paper chromatography

9. Thin Layer Chromatography
10. Column chromatography (Demo)

II- BIOINSTRUMENTATION

1. Fluorescence microscope (Demo)
2. HPLC (Demo)
3. GC-MS (Demo)

III-BIOSTATISTICS

Using Excel, SPSS software

Mean

Standard deviation

Correlation

Regression

ANOVA

IC_{50} value calculation

Teaching Methods

- Google classrooms; information and communication technology; Powerpoint presentations; Board teaching; Demonstration of experiments; Providing hands on training in all the experiments as well as the preparation of reagents; Discussion and Interpretation of results

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	H	S	S	S
CO2	S	M	S	M	M
CO3	M	S	H	S	S

S – Strong **H** – High **M** – Medium **L** – Low

19PBT1CM

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT1CM		C.Pr.2- Lab in Molecular Genetics and Microbiology		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 3

Course Objectives

- To get hands on experience and to learn the principles behind molecular and microbiological techniques
- To give hands on experience in estimation of nucleic acids and isolation of cell organelles
- To train the students on microbiological media preparation, isolation of microbes and staining techniques

Course Outcomes (CO)

K3	CO1	Extending the hands on experience on standard solution preparation, Demonstrating the various pure culture as well as the staining techniques of microbiology and methods in Molecular Genetics
K4	CO2	Developing and applying the skills gained through the molecular and microbiological techniques for research as well as for in the various fields of applied science
K5	CO3	Examining and to analyze the results behind the molecular and microbiological techniques for the development of new techniques in future

Syllabus

I-MOLECULAR GENETICS

1. Estimation of DNA by diphenylamine method
2. Estimation of RNA by Orcinol method
3. Mounting of polytene chromosomes
4. Mitosis onion root tip, Meiosis – flower buds of *Rheo discolor*
5. Barr body identification in buccal cavity of females

II-MICROBIOLOGY

1. Pure culture techniques - Pour, Spread and Streak plate methods
2. Staining techniques - Simple, Negative, Gram, Spore and fungal staining
3. Bacterial motility determination assay
4. Bacterial growth curve by spectrophotometric method
5. Biochemical test for identification of bacteria

19PBT1CM

6. Isolation of microbes (bacteria, fungi and actinomycetes) from soil, air and water
7. Antibiotic sensitivity test by disc diffusion method
8. MBRT test for milk quality analysis
9. Isolation of *Rhizobium* from root nodules of legumes / soil

Teaching Methods

- • Google classrooms; information and communication technology; Powerpoint presentations; Board teaching; Demonstration of experiments; Providing hands on training in all the experiments as well as the preparation of reagents; Discussion and Interpretation of results

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	H	H	S	S
CO2	S	M	S	M	M
CO3	M	S	H	S	S

S – Strong **H** – High **M** – Medium **L** – Low

19PBT205

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT205		C.P. 5 – Genetic Engineering		
Batch 2019-2020	Semester II	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To demonstrate the innovative utilization of manipulating enzymes, various cloning and expression vectors and analysis of genomic sequences.
2. To interpret the applications of genetic engineering in biotechnological research.
3. To educate the strategizing research methodologies employing recombinant DNA techniques.

Course Outcomes (CO)

K1	CO1	The students recall the principles of genetic engineering and the vectors used in cloning, methods of introduction of gene and expression
K2	CO2	The students appreciate the different cloning strategies and their expression
K3	CO3	The students also know about implementation of genetic engineering for different purposes
K4	CO4	The students will investigate the different strategies of recombinant DNA technology and resolve the problems encountered

Syllabus

UNIT I (15 Hours)

Genetic Engineering: Introduction and applications, Steps involved in gene cloning, types of Hosts, DNA manipulative enzymes – Types, Properties and applications of Restriction enzymes, Restriction mapping, DNases, Polymerases, Modifying enzymes and Ligases. Linkers, Adaptors and Homopolymer tailing.

UNIT II (15 Hours)

Cloning Vectors and cloning strategies: Plasmids (pBR322 and pUC18), Phages (λ phage and M13 vectors), Phagemids (pBluescript, pGEM,), Cosmids (pJB8), Shuttle vector, Yeast episomal plasmids, Yeast integrative plasmids, Yeast replicative plasmids, and Artificial Chromosomes (BAC and YAC).

UNIT III (15 Hours)

Functional analysis: Production of recombinant protein (Insulin), recombinant vaccines (Hepatitis B). Physical, Chemical and Biological methods of transformation. Expression vectors (pET) for prokaryotes, Choice of promoters used in expression vectors, Gene cassettes and gene fusion, advantages of fusion proteins, Problems encountered in expressing foreign gene in *E. coli*. DNA analysis in **forensics, medicine and Agriculture***.

19PBT205

UNIT IV (15 Hours)

In vitro transcription and *in vitro* translation. Cell free translation systems: HRT and HART selection. Transposons - Types, mechanism of transposition, Transposon tagging, Operon and gene fusions. Site directed Mutagenesis - Types and uses. RNA interference, siRNA, miRNA, Metagenomic libraries, Phage display

UNIT V (15 Hours)

Alternative cloning strategies: Shot gun cloning. Construction of genomic and cDNA library, RT-PCR, Real Time PCR. Probes-Types (DNA and RNA), properties and methods of labeling. Screening of libraries - Plaque and colony hybridization. Southern and **Northern hybridization***, Antibody based screening.

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. Brown, T.A., (2010). Gene cloning and DNA analysis, An Introduction. John Wiley & Sons
2. Primrose, S.B., and Twyman. R., (2006). Principles of gene manipulation and genomics, 7th edition, Wiley.com
3. Verma P.S., Agarwal V.K., (2010). Genetic Engineering. S Chand & Company.

Reference Books

1. Winnacker, E.L., (2003). From Genes to Clones. Panima Publishing Corporation, New Delhi.
2. Primrose, S.B., Twyman, R.M., Old, R.W., (2001). Principles of Gene Manipulation, 6th Edition. Blackwell Science, London.
3. Glick, B. R., Pasternak, J.J., Patten, C.L., (2010). Molecular Biotechnology: principles and applications of recombinant DNA, 4th Edition, ASM Press, Washington.
4. Watson et al. (1992). Recombinant DNA, 2nd Edition. W.H. Freeman and Co., New York.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	S	M
CO2	H	S	H	M	M
CO3	S	H	H	S	S
CO4	S	S	M	S	M

S – Strong **H** – High **M** – Medium **L** – Low

19PBT206

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT206		C.P. 6 Immunotechnology		
Batch 2019-2020	Semester II	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

- To provide the students with a foundation in immunological processes
- To understand the immune response made in humans to foreign antigens including microbial pathogens
- To give the description of cells involved in the immune response as well to understand how the immune system recognizes self from non-self

Course Outcomes (CO)

K1	CO1	Defining the role of the immune system
K2	CO2	Demonstrating the basic knowledge of the organization and function of the immune system
K3	CO3	Developing immunological concepts and methods to diagnose immune disorders
K4	CO4	Distinguishing the mechanisms that lead to beneficial immune responses and immune disorders

Syllabus

UNIT I (15 Hours)

Immunity: Types of Immunity, Immune system**:** Innate (NK cells, phagocytes and their killing mechanisms (oxygen dependent and independent mechanisms), PAMP, TLR, **complement Biology (pathways)***; acquired immunity concepts (B, T cells and their activation & differentiation) and organs (primary and secondary lymphoid organs), Primary and Secondary immune responses, APCs

UNIT II (15 Hours)

Antigen biology: **Antigen properties***, haptens, adjuvants. *Antibodies:* Structure, classification and Functions. *Antibody diversity:* Gene rearrangement (heavy and light chain). Antigen-antibody interactions (bonding, cross reactivity, affinity and avidity)

UNIT III (15 Hours)

Cell mediated immune responses. *MHC:* Structure of MHC, antigen processing and presentation strategies, MHC and predisposition to diseases, HLA typing; Immune regulation (T suppressor cells). *Cytokines:* Interleukins and interferons and its biological functions

19PBT206

UNIT IV (15 Hours)

Hypersensitivity reactions: Types and mechanisms. Autoimmune disorders - types. Immunodeficiency diseases: Primary (B cell deficiencies: X linked immunodeficiency, T- cell deficiencies (DiGeorge's syndrome), combined B and T cell deficiencies (SCID) and Secondary (SARS). *Transplantation Immunology:* Immune suppression, Graft Vs Host disease

UNIT V (15 Hours)

Tumor immunology: Tumor antigens, tumor immune response and tumor Immuno therapy.

Vaccines: Recombinant vaccines, anti-idiotype vaccines, Hybridoma technology: Production of clones, monoclonal antibodies and applications: catalytic, chimeric and humanized antibodies. *Immunotechnology:* Immunoprecipitation, Immunohisto-chemistry and Flow cytometry, Immunodeficient mouse models: SCID, nude mouse.

Teaching Methods

Board teaching, Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Textbooks

1. Owen, J., Punt, J., Stranford, S., (2013). Kuby's Immunology, 7th Edition. W. H. Freeman and company, New York.
2. Chakravarthy, A. (2009). Immunology and Immunotechnology, Oxford University Press, India

References

1. Rao, CV. (2002). An introduction to Immunology, Narosa Publishing House, Chennai.
2. Khan, Fahim Halim. (2009). The elements of Immunology, Pearson Education (I) Pvt. Ltd.
3. Tizard, I.R. (1995). Immunology: An Introduction. 4th Edition. Saunder's College Publishing, NY.
4. Roitt, I. (1994). Essential Immunology. Blackwell Science, Singapore.
5. Peter J. Delves., Seamus J. Martin., Dennis R. Burton., Ivan M. Roitt. (2016). Roitt's Essential Immunology, 13th edition. Wiley-Blackwell.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	S	S
CO2	S	M	H	M	H
CO3	M	H	S	S	H
CO4	S	S	M	H	M

S – Strong **H** – High **M** – Medium **L** – Low

19PBT207

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT207		C.P. 7 – Animal Biotechnology		
Batch 2019-2020	Semester II	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To make students understand about the basics of animal science
2. To equip students with culture techniques and scope of animal biotechnology
3. To provide knowledge on genetic engineering in the improvement of animal for human welfare

Course Outcomes (CO)

K1	CO1	Students are trained to relate and recall the subject in topic wise
K2	CO2	Lecture topic is summarized to easy understanding of the topic taught
K3	CO3	By applying the specific methods problems identified and rectified
K4	CO4	The outcome of each topic is analyzed critically and made easy to study

Syllabus

UNIT I (15 Hours)

Animal cell culture: Culture media, balanced salt solution (BSS) and simple growth medium. Role of carbon dioxide, serum and glutamine in cell culture, Protein free defined media and their applications. Contamination: sources, types, monitoring and eradication.

UNIT II (15 Hours)

Types of cell culture: Primary and established culture, Cell separation, Biology and characterization of cultured cells, Cell synchronization and cryopreservation, Measuring parameters of growth, Measurement of cell death (Cytotoxicity tests: LDH ,MTT and Clonogenic assay), Organotypic culture: Bone tissue engineering.

UNIT III (15 Hours)

Molecular techniques in cell culture. Cell transformation: Physical, Chemical and Biological methods of gene transfer. **Stem cells and gene therapy (iPSCs for Sickle cell anemia)***. Manipulation of genes: Gene silencing (transcriptional and post-transcriptional) and Gene targeting (Knock-in and knock-out).

19PBT207

UNIT IV (15 Hours)

Expression vectors for animal cells: Viral; SV40, Adeno, AAV, Vaccinia, Retro and hybrid viral vectors, Baculo virus as biocontrol and foreign gene expression, Plasmid expression vectors in animal cells: Classes and common modular components; pSV and pRSV.

UNIT V (15 Hours)

Transgenics: Transgenic animals as models for human diseases, **Applications of transgenic animals and their products** *. Reproductive and Therapeutic cloning. *In vitro* fertilization and embryo transfer: Composition of IVF media, steps involved in IVF, PZD and ICSI. Ethical and religious issues.

** denotes Self study*

Textbook

1. Ranga, M.M.2004 Animal Biotechnology. 2nd Edition. Agrobios Publishers, Jodhpur, India.
2. Singh, B., Gautam, S.K. Chauhan, M.S. and Singla, S.K. 2013. Text book of animal biotechnology. The Energy and Resource Institute Press, New Delhi, India.

References

1. Freshney, R.I. 2015. Culture of Animal Cells: Manual of basic technique and specialized applications, 7th edition. John Wiley Publications, New Jersey, USA.
2. Masters, J.R.W.2000. Animal cell culture: A practical approach series. 3rd Edition. Oxford University Press, London.
3. Primrose, S.B. and Twyman R.M. 2006. Principles of gene manipulation and genomics.7th edition. Wiley Publications, New Jersey, USA.
4. Bernard R. Glick and Jack G/Pasternak. 2010. Molecular Biotechnology. 4th edition. ASM Press, Washington, USA.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	H	H	M
CO2	H	M	H	H	H
CO3	H	H	H	H	H
CO4	S	H	H	H	H

S – Strong **H** – High **M** – Medium **L** – Low

19PBT208

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT208		C.P.8– Environmental Biotechnology and Bionanotechnology		
Batch 2019-2020	Semester II	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To reveal the current status and basics of environmental condition and conservation.
2. To make the students to understand the concepts of ecology and conservation of environment through advance technology.
3. To provide knowledge of current perspectives in ecological issues and advance Bionanotechnology applications

Course Outcomes (CO)

K1	CO1	Students are trained to relate and recall each and every topic
K2	CO2	Students accept and understand the ecological status and their conservation
K3	CO3	Qualitative application are employed by the students to ensure the quality (good or bad) of the environmental samples for the betterment of society through advance technology
K4	CO4	Reported data and observed results are analyzed and interpreted by students

Syllabus

UNIT I (15 Hours)

Water Pollution and control – Introduction - need for water management, measurement and sources, water pollution. Physio-chemical characteristics of wastewater, Effluent treatment - aerobic and anaerobic digestion, biogas from waste, biocontrol agents.

UNIT II (15 Hours)

Removal of specific pollutants: Use of aquatic plants including transgenics in biotechnology, biodegradable natural polymer. Microbial system for heavy metal accumulation, Biosorption, Bioremediation: Types, applications and examples. Bioindicators and Environmental impact assessment.

UNIT III (15 Hours)

Xenobiotic compounds - hazardous wastes, genetic engineering approach for biodegradation, degradative plasmids detoxification methods. Solid-waste management (4R principle) and sewage-sludge disposal and utilization. Biodegradation of wastes from pesticide, textile, tannery and paper industries.

19PBT208

UNIT IV (15 Hours)

Background to Nanoscience: definitions of Nanotechnology, Emergence and challenges of Nanoscience and Nanotechnology, type of nanomaterials, properties of nanomaterials. Synthesis of nanoparticles biological route (plant, microbial and natural compounds), Characterization of nanomaterials – UV-Vis, FTIR.

UNIT V (15 Hours)

Application of Nanotechnology: Nanotechnology for medicine and waste reduction and improved energy efficiency, **nanotechnology based water treatment strategies***. Nanoporous polymers and their applications in water purification, Use of nanoparticles for environmental remediation and water treatment.

** denotes Self study*

Textbook

1. Jogdand, S. N. 1995. Environmental Biotechnology. Himalaya Publishing House, New Delhi.
2. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 2012

References

1. Cheremisinaff, N.P., 2003. A textbook for waste and waste water treatment. Prentice Hall of India Pvt. Ltd., New Delhi.
2. Cruger, W. and A. Cruger 2003. A Textbook of Industrial Microbiology. Panima Publishing Corporation, New Delhi.
3. Glazer, A.N. and H. Nikaido, 1995. Microbial Biotechnology, W.H. Freeman and Co., NY
4. Dupas C., Houdy P., Lahmani M., "Nanoscience: Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	H	H	M
CO2	H	M	H	H	H
CO3	H	H	H	H	H
CO4	S	H	H	H	H

S – Strong **H** – High

M – Medium **L** – Low

19PBT2CN

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code: 19PBT2CN		C.Pr.3 – Lab. in Molecular biology and Genetic Engineering		
Batch 2019-2020	Semester II	Hours / Week 5	Total Hours 75	Credits 3

Course Objectives

1. To enrich the students to have practical experience on molecular biology and genetic engineering
2. To have hands on experience in isolation, manipulation of DNA, RNA, protein and identification of gene and its expressions
3. To execute the applications of molecular biology, recombinant DNA technology, environmental biotechnology in research and industries

Course Outcomes (CO)

K3	CO1	The students gain the technical skills involved in extraction, manipulation of biomolecules and identification of gene and its expressions
K4	CO2	The students develop and apply the modern technology of molecular biology and genetic engineering in industries and research
K5	CO2	The students will examine the results obtained using molecular biology and genetic engineering

Syllabus

I - MOLECULAR BIOLOGY

1. Isolation of genomic DNA-Bacteria, Blood, Plant
2. Agarose gel electrophoresis
3. Isolation of plasmid DNA from bacteria
4. Competent cell preparation and Bacterial transformation
5. Isolation of RNA
6. Polyacrylamide gel electrophoresis

19PBT2CN

II - GENETIC ENGINEERING

1. Phage titration
2. Restriction digestion and Ligation
3. Southern blotting
4. Northern blotting
5. Designing of specific primers using Software
6. Amplification by Polymerase Chain Reaction - Colony PCR, Differential temperature PCR and touch-down PCR
7. cDNA synthesis
8. *in vitro* site directed mutagenesis by using PCR method
9. Gene Expression - Real time PCR (Demo only)

Teaching Methods

- Google classrooms; information and communication technology; Powerpoint presentations; Board teaching; Demonstration of experiments; Providing hands on training in all the experiments as well as the preparation of reagents; Discussion and Interpretation of results

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO3	H	S	M	H	M
CO4	M	H	H	S	S
CO5	H	M	M	S	H

S – Strong **H** – High **M** – Medium **L** – Low

19PBT2CO

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code : 19PBT2CO		C.Pr.3 - Lab in Immunotechnology, Animal Biotechnology and Environmental Biotechnology		
Batch 2019-2020	Semester II	Hours / Week 5	Total Hours 75	Credits 3

Course Objectives

- To teach students the latest techniques and principles in Immunotechnology, animal biotechnology and environmental biotechnology
- To give hands on experience in immunological techniques
- To provide hands on training on animal cell culture techniques and environmental biotechnology

Course Outcomes (CO)

K3	CO3	Defining the fundamental concepts of immunology, disease diagnosis and animal tissue culture techniques
K4	CO4	Developing and applying the recent technology involved in diagnostic techniques of immunology and animal cell culture
K5	CO5	Examining and analyzing the results involved in immune techniques animal biotechnology and environmental biotechnology

Syllabus

I – IMMUNOTECHNOLOGY

1. Production and purification of IgG.
2. Immunoassay for particulate antigens.
3. Qualitative and Quantitative haemagglutination.
4. Radial immunodiffusion.
5. Ouchterlony double diffusion.
6. Immunoelectrophoresis.
7. Rocket immunoelectrophoresis.
8. Immunodiagnosis (ELISA).
9. Western blotting.
10. Peripheral Blood mononuclear cell separation.

19PBT2CO

II – ANIMAL TISSUE CULTURE

1. Preparation of tissue culture medium and membrane filtration
2. Chick fibroblast cells isolation
3. Preparation of primary cells
4. Cell counting and cell viability
5. Trypsinization of monolayer and subculturing
6. Cytotoxicity test-MTT assay
7. DNA fragmentation analysis
8. Demonstration of animal handling for experimental purposes, cervical dislocation, dissection of mice, cardiac puncture, blood sample preparation and its handling
9. Comet assay (Demo)

III – ENVIRONMENTAL BIOTECHNOLOGY

1. Estimation of biological oxygen demand in water / sewage samples
2. Estimation of chemical oxygen demand in water / sewage samples
3. Determination of total dissolved solids in water / sewage samples
4. Water Quality analysis by MPN test
5. Isolation xenobiotic degrading bacteria by selective enrichment technique
6. Bio-decolorization of dyes
7. Biosorption of heavy metals (Demo)
8. Estimation of fluoride

Teaching Methods

• Google classrooms; information and communication technology; Powerpoint presentations; Board teaching; Demonstration of experiments; Providing hands on training in all the experiments as well as the preparation of reagents; Discussion and Interpretation of results

19PBT2CO

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO3	M	S	M	S	M
CO4	H	S	H	M	H
CO5	S	M	M	H	S

S – Strong **H** – High **M** – Medium **L** – Low

19PBT309

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code : 19PBT309		C.P.9 - Fermentation Technology		
Batch 2019-2020	Semester III	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To learn the concepts of screening, optimization and maintenance of cultures and to introduce the students to the various concepts of microbial growth kinetics, fermentation and bioprocess engineering
2. To understand the basics of fermentation techniques and to enable the students to learn about the design of fermentors
3. To know about the principles involved in transport mechanisms and techniques involved in Upstream and downstream bioprocessing.

Course Outcomes (CO)

K1	CO1	Recognizing the basic principles of bioprocess technology and different types of fermenters
K2	CO2	Understanding the different processes involved in bioprocess technology
K3	CO3	Integrating scientific and technological knowledge on the use of bioprocesses for industrial products on the cell and process level
K4	CO4	Developing and assessing the conditions for efficient and sustainable design of bioprocesses

Syllabus

UNIT I (15 Hours)

Introduction: Basic principles, **scope and advantages of bioprocess technology***. *Fermentation systems:* Batch, fed batch and continuous. Kinetics of microbial growth, specific growth rate, substrate utilization and product formation; Phases of cell growth, Factors affecting cell growth, Kinetic model for cell growth: Monod's model and yield coefficients.

UNIT II (15 Hours)

Bioreactor: Components design and mode of operations. *Types of bioreactors:* CSTR, packed bed, batch, Air lift bioreactor, Bioreactors for immobilized cells, animal cells, ~~waste water and effluent treatment~~. Specialized bioreactors: pulsed, fluidized and photobioreactors.

19PBT309

UNIT III (15 Hours)

Upstream processing: Introduction, principles of microbial nutrition, Media formulation and optimization. Sterilization: Methods of sterilization- Batch and continuous sterilization. Air sterilization, design and air filters~~. aseptic operation of fermentor~~ Inocula development for Industrial fermentations- Inoculum source – Seed culture; development of inocula for yeast, bacteria and fungi. Scale up and scale down.

UNIT IV (15 Hours)

Transport phenomena: Mass and heat transfer mechanism. Mass, heat and oxygen transfer coefficients..

Bioprocess monitoring and control: On-line and Off-line analysis. *Monitoring variables:* pH, temperature, pressure, flow rate, DO_2, agitation and foam level. PID control

UNIT V (15 Hours)

Downstream processing: Introduction. Primary separation - Cells, Solid matter and foam- precipitation, filtration, centrifugation, cell disruptions (Mechanical, enzymatic and chemical). Product isolation - solvent extraction, adsorption, aqueous two-phase system and precipitations (Ammonium Sulfate, solvent). Purification techniques: Chromatography (ion-exchange, gel-permeation and affinity), membrane separation (microfiltration, Ultrafiltration, nanofiltration, and reverse osmosis). Product recovery; product polishing (drying– spray driers, drum driers and freeze driers and crystallization).

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Textbooks

1. Stanbury, P. F., Whitaker, A., Hall, S. J., (2016). Principles of Fermentation Technology, Third edition. Butterworth-Heinemann Elsevier Ltd, Oxford, United Kingdom.
2. Sathyanarayana, U., (2008), Biotechnology, Books & Allied (P) Ltd.
3. W. Cruger and A. Cruger. (2003) A Textbook of Industrial Microbiology. Panima Pub. Corp., New Delhi.

References

1. Shuler, M.L., Kargi, F., (2003) Bioprocess engineering: Basic Concepts Prentice Hall, Engelwood Cliffs.
2. Heat and Mass Transfer in SI units R.K. Rajput. S., Chand and Co. Ltd., New Delhi. 2003.
3. Industrial Microbiology. L.E. Casida., (2002) John Wiley & Sons Inc., United States

4. Primrose, S.B., (2001) Molecular Biotechnology, 2nd edition, Panima Publishing Corporation, New Delhi.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	M	M
CO2	H	M	S	M	S
CO3	M	H	M	S	S
CO4	M	M	H	S	S

S – Strong **H** – High **M** – Medium **L** – Low

19PBT310

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code : 19PBT310		C.P.10 - Plant Biotechnology		
Batch 2019-2020	Semester III	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To make students understand about the basics of plant science
2. To equip students with culture techniques and scope of plant biotechnology
3. To provide knowledge on genetic engineering in the improvement of plants for human welfare

Course Outcomes (CO)

K1	CO1	Students are practiced to remember the specific terminologies by label the scientific words
K2	CO2	Students are explained wit neat diagrams to understand the topic easily
K3	CO3	Students are allowed to apply and utilize the scientific models for every topic
K4	CO4	Students are triggered to assume and analyze the each chapter in detail

Syllabus

UNIT I (15 Hours)

Genome organization: Nucleus, Chloroplast and Mitochondria. Quantitative trait loci (QTL) and Linkage analysis. Molecular markers: RFLP, RAPD, AFLP, STS, Microsatellites (SSR/STR), SCAR (Sequence Characterized Amplified Regions) and SSCP, Molecular marker assisted selection, Genome editing: CRISPR-Cas9.

UNIT II (15 Hours)

Plant cell and tissue culture: Types of media, Sterilization*, and Growth regulators. In vitro propagation techniques: Micropropagation, Callus culture, Cell culture; suspension and single cell culture, Protoplast isolation; culture and somatic hybridization, Somatic embryogenesis and Synthetic seed preparation, Anther/pollen and embryo culture. Somaclonal variation. Production of secondary metabolites through plant cell culture.

UNIT III (15 Hours)

Direct and indirect gene transfer, Binary and cointegrate vector systems, Agrobacterium characteristics; Ti and Ri plasmids, mechanism of T-DNA transfer. Chloroplast transformation. Gene tagging.

19PBT310

UNIT IV (15 Hours)

Plant viral vectors: CaMV and Gemini viruses. Gene constructs, Markers genes for selection of transformants, Gene silencing. Applications of plant transformation: Nutraceuticals (Golden rice and Flavr Savr), Herbicide resistance, Insect and Virus resistance, Terminator technology, Pathogenesis related proteins and Marker free transgenics.

UNIT V (15 Hours)

Transgenic plants for abiotic stress resistance (salt, drought and cold), Recombinant proteins; Plantibodies and Plantigens, Biodegradable plastic. Metabolic engineering for plant secondary metabolites: Introduction, Alkaloid and Flavonoid biosynthesis.

** denotes Self study*

Text books

1. Chawla, H. S. 2002. Introduction to Plant Biotechnology. 2nd Edition, Science Publishers, Inc., Enfield, NH, USA.
2. Kalyan Kumar De. 2004. An Introduction to Plant Tissue Culture.2008. New Central Book Agency, Kolkata.
3. Dubey, R.C., 2013. A text book of Biotechnology (Revised Edition), S. Chand & Company Ltd. New Delhi.
4. Razdan, M. K., 2003. Introduction to Plant Tissue Culture. 2nd Edition, Science Publishers, Inc., Enfield, NH, USA.

Reference Books

1. Slater, Scott and Fowler, 2008. Plant Biotechnology, 2nd Edition, Oxford University Press.
2. Primrose, S.B. and Twyman, R. 2006. Principles of Gene Manipulation and Genomics. 7th Edition, Blackwell Publishing, Malden, MA, USA.
3. Buchanan, Gruissem and Jones.2000. Biochemistry and Molecular Biology of Plants. John Wiley & Sons, UK.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	H	H	H
CO2	S	H	H	H	H
CO3	H	S	M	H	H
CO4	H	H	H	H	H

S – Strong **H** – High **M** – Medium **L** – Low

19PBT411

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code : 19PBT411		C.P.11- Genomics, Proteomics and Computational Biology		
Batch 2019-2020	Semester IV	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To study and deduce the molecular characterization of human genome
2. To study the techniques involved in structural and functional proteomics
3. To utilize the bioinformatic tools to design and development of novel drugs

Course Outcomes (CO)

K1	CO1	Commemorating the molecular techniques involved in characterization of genomes and proteomes
K2	CO2	Recognizing and interpret the techniques involved in genomics, proteomics, bioinformatics
K3	CO3	Administering the principles of genomics, proteomics, bioinformatics to discovery novel drug development
K4	CO4	analyzing the molecular markers and its applications

Syllabus

UNIT I (15 Hours)

Genomics: Genomes of bacteria and eukaryotes- topology, organization. Human Genome Project: Historical background; Human genome features-protein coding regions repetitive sequences and pseudogenes. **Ethical, legal, social implications of HGP*.**

UNIT II (15 Hours)

Mapping and Sequencing: Molecular markers for genome analysis – RFLP, AFLP, RAPD and SNP, Genetic and Physical maps- Pedigree analysis, Restriction mapping, FISH, STS mapping with radiation hydrid panels; DNA and Genome sequencing- Automated sequencing of DNA, Shotgun sequencing; Contig assembly.

UNIT III (15 Hours)

Proteomics: Structural proteomics- NMR, X-ray crystallography and Mass spectroscopy. Functional Proteomics - 2D analysis of cellular proteins, Yeast two hybrid system, Protein micro arrays, MALDI-TOF, SELDI-TOF and ESI.

19PBT411

UNIT IV (15 Hours)

Introduction to Systems Biology: Developmental biology and DNA microarrays differential gene expression – regulation of genes – microarray, tagging – documentation – Stanford microarray database – data normalization –. Tools and data formats for modeling - simulation techniques, simulation tools, data formats – SMBL, BioPAX, EMBL, **FASTA***, GCG and ClustalW standard for systems biology, data resources – Nucleic acid and protein databases, pathway, kinetic and model database and biomodels. BLAST: types, steps involved in use, interpretation of results, multiple sequence alignment, Phylogenetic analysis

UNIT V (15 Hours)

Computational Biology: Analysis of high-throughput data: High-throughput experiments, Next generation sequencing, image analysis and data quality control, grid finding, spot quantification, linear models, Medical informatics, Disease genes identification and drug targets **analysis of gene expression data***, DNA arrays, ROC curve analysis, clustering algorithms, hierarchical clustering, self-organizing map (SOMs).

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. Brown, T.A. 2017, *Genomes 4*, CRC Press is a member of Taylor & Francis Group.
1. Lesk, AM., 2002 Introduction to Bioinformatics, Oxford University Press, UK.

References

1. Sandy B. Primrose, Richard Twyman 2007, Principles of Gene Manipulation and Genomics, 7th edition, Willey-Blackwell.
2. Daniel. C. Liebler, 2002. Introduction to Proteomics. Humana Press.
3. Tsai, C.S. 2002. An Introduction to Computational Biochemistry, Wiley-Liss, Inc., NY.

19PBT411

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	M	S
CO2	H	S	S	M	M
CO3	S	H	S	S	M
CO4	S	M	M	H	S

S – Strong H – High M – Medium L – Low

19PBT3CP

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code : 19PBT3CP		C. Pr. 4 – Lab in Fermentation Technology, Plant Biotechnology and Computational Biology		
Batch 2019-2020	Semester III	Hours / Week 5	Total Hours 75	Credits 3

Course Objectives

1. To gain hands-on experience and to learn the principles behind fermentation technology, plant biotechnology and bioinformatics
2. To know the process involved in isolation, separation, manipulation of bioprocessing, plant cell culture techniques
3. To apply the technology in pharmaceutical industries and plant tissue culture based industries

Course Outcomes (CO)

K3	CO1	Applying the concepts involved in fermentation technology, plant biotechnology and bioinformatics and demonstrating the techniques involved in Fermentation technology, plant cell culture and bioinformatics
K4	CO2	Executing the recent technology involved in bioinformatics, bioprocessing and plant cell culture
K5	CO3	Evaluating and analyzing the results involved in fermentation technology, plant biotechnology and bioinformatics

Syllabus

I – FERMENTATION TECHNOLOGY

1. Parts and design of a bioreactor.
2. Isolation of Protease producing bacteria
3. Optimization of culture condition for growth and protease production (media, pH & temperature).
4. Wine production and estimation of ethanol.
5. Production of organic acid- Lactic acid.
6. Immobilization of cells and test for its activity
7. Purification of fermentation product by Ion exchange Chromatography
8. Preparation of Biofertilizer-
9. Mushroom cultivation

19PBT3CP

II - PLANT BIOTECHNOLOGY

1. Micropropagation- Nodal and shoot tip culture
2. Callus culture
3. Cell suspension culture
4. Isolation of protoplast (Demo)
5. Synthetic seed preparation
6. Somatic Embryogenesis
7. Anther culture
8. Regeneration and Hardening
9. *Agrobacterium* mediated transformation – hairy root culture (Demo)

III - COMPUTATIONAL BIOLOGY

1. File Formats of Nucleic acid and aminoacid sequences
2. Sequence similarity searching using NCBI (BLAST)
3. Protein Data banks (SWISPROT and ExPASy)
4. Multiple sequence alignment (ClustalW)
2. Phylogenetic analysis
3. Molecular Docking

Teaching Methods

- Google classrooms; information and communication technology; Powerpoint presentations; Board teaching; Demonstration of experiments; Providing hands on training in all the experiments as well as the preparation of reagents; Discussion and Interpretation of results

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	H	S	M
CO2	H	M	S	M	S
CO3	M	H	H	S	S

S – Strong **H** – High **M** – Medium **L** – Low

19PBT4Z1

Programme code: 08		Programme title: M.Sc. Biotechnology		
Course code : 19PBT4Z1		Project work and viva-voce		
Batch 2019-2020	Semester IV	Hours / Week 5	Total Hours 75	Credits 3

Course Objectives

1. To develop independence in experimental design and interpretation and to develop research skills
2. To promote education and research in biotechnology and provide academic and professional excellence for immediate productivity in industrial, governmental, or clinical settings for an ultimate benefit of society and environment

Course Outcomes (CO)

K3	CO1	Developing and executing the knowledge by planning and coordinating a project.
K4	CO2	Inducing the students to become scientist
K5	CO3	Have gained practical experience in planning of projects and project management in biotechnological industry

DIRECTIONS

- Students are allocated a dissertation topic individually under the supervision of faculty of the department.
- The dissertation must be similar to the thesis style and encompass:
  - (i) Introduction / Rationale and Review of Literature
  - (ii) Materials and Methods
  - (iii) Results
  - (iv) Discussion
  - (v) Bibliography
- The dissertation should be submitted in type-written, bound form to the department for record.
- While evaluation of dissertation, 40 marks (20+20 as internal) should be based on oral presentation before the faculty members of department in the presence of concerned supervisor during the period of CIA examinations by submitting the reports, and 160 marks (external) should include:
  - (i) Evaluation of project work (100 marks) based on:
    - (a) Scientific content (25marks)
    - (b) Experiments and final outcome (50 marks)

(c) Presentation (25 marks)

(ii) Viva-voce by external examiner (20 marks)

(iii) Assessment through presentation by internal examiner (40 marks) at the time of examination.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	S	S	H
CO2	M	S	H	H	S
CO3	S	M	H	M	H

S – Strong **H** – High **M** – Medium **L** – Low

PBT45

Major Elective

Programme code: 08	Programme title: M.Sc. Biotechnology		
Major Elective – Pharmaceutical Biotechnology			
Batch 2019-2020	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To enable the students to learn about various drugs, its effects, drug metabolism, drug receptors, drug tolerance, dependence and resistance with therapeutic monitoring of drugs.
2. To offers the students comprehensive information and insights in pharmaceutical biotechnology and the development of biopharmaceuticals in pharmaceutical industry.

Course Outcomes (CO)

K1	CO1	Recollecting the concept, classification production and application of pharmaceutical substances
K2	CO2	Imparting a comprehension of basic skills necessary for employing biotechnology principles
K3	CO3	The knowledge gained in this course would be used to understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related products on the market
K4	CO4	Understanding in both scientific knowledge of designing and mechanism of action of drugs

Syllabus

UNIT I (15 Hours)

Drugs – sources, dosage forms and routes of administration. Drugs – structural features and pharmacological activity, Prodrug concept. Absorption and factors modifying drug absorption. Distribution, metabolism and excretion of drugs – phase I, II reactions, and action of cytochrome P450. Toxicity

UNIT II (15 Hours)

Drug receptors – localization, types and subtypes, models and theories. G-protein coupled receptor and ion-channel linked receptors. **Examples of drug-receptor interactions*.** Agonists and antagonists.

Major Elective

UNIT III (15 Hours)

Drug tolerance and drug dependence. Principles of basic pharmacokinetics. Adverse response to drugs, drug intolerance, pharmacogenetics, drug allergy, tachyphylaxis, drug abuse, vaccination against infection, factors modifying drug action and effect. Assay of drug potency: chemical, bioassay and immunoassay.

UNIT IV (15 Hours)

Biotechnology and Pharmacy: Genetically engineered protein and peptide agents. Drug delivery systems: Non-conventional routes of administration, anti-AIDS drug development, oncogenes as targets for drugs, multidrug resistance and production of secondary metabolites.

UNIT V (15 Hours)

Mechanism of action of drugs: used in therapy of Respiratory system – cough, bronchial, asthma, pulmonary tuberculosis, Antimicrobial drugs – sulfonamides, trimethoprim, penicillins, aminoglycosides and bacterial resistance, **Cancer chemotherapy*,** Thyroid and antithyroid drugs, insulin and oral antidiabetic drugs, antifertility and ovulation inducing drugs.

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Textbooks

1. The pharmacology, Volumes I and II – Goodman, Gilman.
2. Pharmacology 3rd edition – Rang, Tale.
3. Principles of medicinal chemistry – Foye, Waverks Pvt. Ltd. New Delhi.

References

1. Basic and clinical pharmacology 7th edition – Katzung, Printice Hall, New Delhi
2. Pharmacology and pharmacotherapeutics – Satoskar *et al.,* Popular Prakashar, Mumbai
3. Burger's medicinal chemistry and drug discovery: principles and practice – Wolf, John Wiley
4. Molecular basis of inherited diseases – Davies, Read, IRL Press
5. Molecular biotechnology 2nd edition – Glick, Pasternak, Panima Publishers, 2002

PBT47

Major Elective

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	H	H
CO2	H	M	S	M	S
CO3	S	H	H	M	M
CO4	H	S	S	H	H

S – Strong **H** – High **M** – Medium **L** – Low

PBT48

Major Elective

Programme code: 08	Programme title: M. Sc. Biotechnology		
Major Elective – Bioethics, Biosafety, IPR and Total Quality Management			
Batch 2019-2020	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To understand the concepts of bioethics, biosafety of genetic engineering, IPR, TQM, product planning and development through entrepreneurship
2. To learn the principles of bioethics and to know the requirements and assessment of biosafety
3. To make the students to understand the scope and significance of TQM

Course Outcomes (CO)

K1	CO1	Define the concepts of IPR, TQM, Product planning and development
K2	CO2	Understanding the scope and significance of biosafety in biotechnological process
K3	CO3	Developing knowledge on biosafety assessment in genetically modified organisms and their release into the environment
K4	CO4	Motivating the entrepreneurial development in life science

Syllabus

UNIT I (15 Hours)

Intellectual property rights: Introduction and the need for IPR, IPR in india, Copy Right, Design, Trademark, Geographical indications, Farmer's Right, Plant Breeder's Right

UNIT II (15 Hours)

Patents : Concepts and principle of patenting – patentable subject matter, Procedure for obtaining patent – Rights of patent, Infringement of patent right, Remedies for infringement of patent rights-patentability and emerging issues

UNIT III (15 Hours)

Bioethics : **Principles of bioethics***, ethical conflicts in biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global biotech issues.

Major Elective

UNIT IV (15 Hours)

Biosafety: Definition of Biosafety. Requirements, Biosafety for human health and environment Use of genetically modified organisms and their release into the environment, biosafety assessment procedures for biotech foods & related products, Cartagena protocol on biosafety, bioterrorism and convention on biological weapons, WIPO, **GATT*.**

UNIT V (15 Hours)

Principles of TQM, Tools, steps, techniques and methods for TQM (six sigma, charts, Ishikawa diagram, tree diagram, RCA, PDCA cycle), Requirements for supplementing TQM - steps for supplementing TQM - questionnaire - assessment through questionnaire, mission statement, benefits of TQM, check list for implementing TQM, Case study.

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. Sasson A., (1993), Biotechnologies in developing countries present and future, UNESCO Publishers.
2. Gurumani, N., (2006), Research Methodology for Biological Sciences. M JP Publishers,

Reference Books

1. Shantharam S., and Jane F. Montgomery., (1999), Biotechnology Biosafety, and Biodiversity**,** Scientific and Ethical Issues for Sustainable Development, CC Now Science Publishers.
2. Drucker, P.F., (1999), Innovation and entrepreneurship: Practice and Principles, - Butterworth-Heinemann, Harper Business, NY.
3. Rao, Carr, Dambolena and Kopp. Across functional perspectives of TQM. John Wileyand sons, Newyork.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	M	M	H	S
CO2	S	H	H	H	M
CO3	S	H	S	S	S
CO4	M	M	M	H	S

S – Strong **H** – High **M** – Medium **L** – Low

PBT50

Major Elective

Programme code: 08		Programme title: M.Sc. Biotechnology		
Major Elective - Natural Products				
Batch 2019-2020	Semester -	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To understand the concepts, developments, applications of natural products
2. To recollect the model approaches in natural products improvement
3. To know the novel methods in cultivation and conversation of natural products.

Course Outcomes (CO)

K1	CO1	Introducing the principle and concepts in natural products
K2	CO2	Updating the role of natural products extraction process
K3	CO3	Studying the advanced development in natural production utilization and conservation.
K4	CO4	Discussing the various therapeutic applications of natural products.

Unit-I (15 hours)

Sources of crude drug: Biological, marine, Mineral and plant tissue culture as source of natural products. Various methods of extraction and isolation of phytopharmaceuticals namely infusion, decoction, maceration, percolation, hot continuous extraction, successive solvent extraction, supercritical fluid extraction, steam distillation, Counter-current Extraction, Ultrasound Extraction (Sonication). Parameters for selection of suitable extraction process.

Unit-II (15 hours)

Phytochemical Screening: Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cynogenetic glycosides, amino acids in plant extracts. Important therapeutic classes: antimicrobial, antidiabetics, hepatoprotectives, immmunomodulators, anti-cancer.

Unit-III (15 hours)

Herbal cosmetics: Importance of herbals as shampoos (soapnut), conditioners and hair darkeners, (amla, henna, hibiscus, tea), skin care (aloe, turmeric, lemon peel, vetiver); Colouring and Flavouring agents from plants; Utilization of aromatic plants and derived products with special reference to sandalwood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and **eucalyptus oil***.

PBT51

Major Elective

Unit-IV (15 hours)

Nutraceuticals and Health Foods: Classification of Nutraceuticals, Health foods: Source, Chemical constituents, uses, actions and commercial preparations of, following health foods, Alfalfa, Bran, Angelica, Chamomile, Corn oil, Fenugreek, Ferverfew, Garlic, Ginseng, Ginkgo, Honey, Hops, Safflower oil, Soyabean Oil, Turmeric. Concept and examples of Adaptogens

Unit-V (15 hours)

Quality control of herbal drugs as per WHO, AYUSH and Pharmacopoeial guidelines-Extractive values, ash values. Determination of heavy metals, insecticides, pesticides and microbial load in herbal preparations.

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. S.S.Agrawal, Herbal drug technology, Universities press
2. N.R. Krishnaswamy Chemistry of Natural Products: A Unified Approach, University Press (India) Ltd., Orient Longman Limited, Hyderabad, 1999.

Reference Books

1. Manual K. Lindsey, Plant Tissue Culture, Springer U.K. Wagner.
2. Wagner and Bladt, Plant Drug analysis, Springer U.K.
3. A.R.Kashi, Industrial Pharmacognosy, Universities press
4. Quality Standards of Indian Medicinal Plants, Vol 10, (ICMR), New Delhi, 2012.
5. Indian Herbal Pharmacopoiea, K. M. Varghese Co.Bombay.
6. Craker L., Herbs, Spices and Medicinal Plants, CBS Publishers

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	M	S	H
CO2	S	H	H	M	H
CO3	S	H	H	H	H
CO4	M	M	M	H	M

S – Strong **H** – High **M** – Medium **L** – Low

PBT52

Major Elective

Programme code: 08		Programme title: M.Sc. Biotechnology		
Major Elective - Bioentrepreneurship, Marine and algal biotechnology				
Batch 2019-2020	Semester -	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To understand the concepts of Entrepreneurial traits.
2. To understand the concepts of business idea to project design to project appraisal
3. To recollect the biotechnological approaches in marine and algal technology for multiple applications.
4. To know the novel methods development in marine and algal products.

Course Outcomes (CO)

K1	CO1	Introducing the basic concepts in Bio entrepreneurship
K2	CO2	Updating the role of business ides in marine and algal products.
K3	CO3	Studying the advanced development in marine and algal natural products utilization and conservation.
K4	CO4	Discussing the various therapeutic applications of marine system

Unit-I: (15 hours)

Introduction: Entrepreneur, Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology, pillars of bio-entrepreneurship and major start-ups in Biotechnology, Concept and theories of Entrepreneurship, Entrepreneurial traits and motivation, Nature and importance of Entrepreneurs, Government schemes for commercialization of technology (eg. Biotech Consortium India Limited)

Unit-II (15 hours)

Project management: Search for a business idea, concept of project and classification, project identification, project formulation, project design and network analysis, project report, project appraisal.

Unit –III (15 hours)

Importance of marine viruses. Red sea tide and its control. Molecular Biology of Green mussel adhesive protein, Marine organism as a source of Polysaccharides. Antimicrobials and antioxidants. Biofouling and prevention Probiotic bacteria and their importance in aquaculture. Vaccines for aquaculture. Transgenic Fish and its economic importance.

PBT53

Major Elective

Unit –IV (15 hours)

Algae -Type Study Structure and reproduction with reference to the following algal forms -Anabaena, Chlorella, Volvox, Chara, Ectocarpus, Sargassum, Polysiphonia and Gracilaria. (Excluding the developmental stages).

Unit – V (15 hours)

Economic importance of algae: Algae as food and fodder, use of algae in agriculture and space research, commercial products of algae: **Agar Agar***, Alginates, Carrageenin, diatomite, mucilage, minerals and elements - Algae in medicine and biofuels.

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. A Textbook of Algae. Tata McGraw- Hill publishing Company Limited, New Delhi.

2. Bilgrami, K.S. and Saha, L.C. 2012. A Textbook of Algae. CBS Publishers & Distributors Pvt. Ltd., New Delhi.

Reference Books

1. Microbiology of deep sea hydrothermal vents (1995). Karl, D.M.

2. Recent Advances in Marine Biotechnology, Vol.2 (1998). Fingerman, M., Nagabushanam, R., Thompson, M.

3. The Business of Biotechnology: From the Bench of the Street: By Richard Dana Ono Published Butterworth- Heinemann, 1991.

4. Entrepreneurship in Biotechnology: Managing for growth from start-up By Martin Gross Mann, 2003

5. Innovation and entrepreneurship in biotechnology: Concepts, theories & cases by D. Hyne & John Kapeleris, 2006

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	M	S	H
CO2	S	H	H	M	H
CO3	S	H	H	H	H
CO4	M	M	M	H	M

S – Strong **H** – High **M** – Medium **L** – Low

PBT54

Non-Major Elective

Programme code: 08	Programme title: M.Sc. Biotechnology		
Non-Major Elective – Competitive Science-I			
Batch 2019-2020	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To understand the physiology of plant
2. To recall the physiology of animal
3. To know the principle and concepts of ecology

Course Outcomes (CO)

K1	CO1	Studying the concept of plant physiology
K2	CO2	Studying the principles of animal physiology
K3	CO3	Studying the basics of environment
K4	CO4	Discussing the principles of ecology

Syllabus

UNIT I (15 Hours)

Blood and circulation - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

UNIT II (15 Hours)

Respiratory system - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Nervous system - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs - Vision, hearing and tactile response. Excretory system - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

UNIT III (15 Hours)

Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization. H. Stress and adaptation I. Digestive system - Digestion, absorption, energy balance, BMR. J. Endocrinology and reproduction - Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation

Non-Major Elective

UNIT IV (15 Hours)

Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway. Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis. Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates. Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. H. Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

UNIT V (15 Hours)

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Species Interactions: Types of interactions, interspecific competition, **herbivory, carnivory***, pollination, symbiosis. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. Essentials of Animal Physiology – Rastogi
2. Basic Ecology: Fundamentals of Ecology – Eugene P. Odum

Reference Books

1. Schaums Outline of Human Anatomy and Physiology, Third Edition (Schaums Outline Series)
2. Plants Physiology – Lincoln Taiz and Eduardo Zeiger
3. Plant Physiology – Ross and Salisbury
4. Ecology and Environment – PD Sharma

Non-Major Elective

5. Ecology: Principles And Applications – JL Chapman and MJ Reiss

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	M	S	H
CO2	S	H	S	M	S
CO3	S	S	M	H	H
CO4	M	M	M	H	M

S – Strong **H** – High **M** – Medium **L** – Low

PBT57

Non-Major Elective

Programme code: 08	Programme title: M.Sc. Biotechnology		
Non-Major Elective – Competitive Science-II			
Batch 2019-2020	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To realize the concepts and principle of evolution
2. To recall the concepts of molecular evolution
3. To discuss the commercial applications of biotechnology

Course Outcomes (CO)

K1	CO1	Introducing the principle and concepts in evolution
K2	CO2	Studying the concepts of molecular evolution
K3	CO3	Studying the methods and approaches in the study of behavior
K4	CO4	Discussing the applications of biology

Syllabus

UNIT I (15 Hours)

Emergence of evolutionary thoughts Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953)

UNIT II (15 Hours)

The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism. Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.

UNIT III (15 Hours)

Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence. E. The Mechanisms: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift;

Non-Major Elective

Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

UNIT IV (15 Hours)

Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

UNIT V (15 Hours)

Applied biology: Microbial fermentation and production of small and macro molecules. Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for plants and animals. Transgenic animals and plants, molecular approaches to diagnosis and strain identification. Genomics and its application to health and agriculture, including gene therapy. Bioresource and uses of biodiversity. Breeding in plants and animals, including marker – assisted selection. **Bioremediation and phytoremediation*.** Biosensors

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

Text Books

1. Organic Evolution (Evolutionary Biology) – Veer Bala Rastogi
2. Introduction To Plant Tissue Culture – Razdan MK

Reference Books

1. Plant Breeding Principles & Methods – 2015 – B.D. Singh
2. Genomes 3 – T.A. Brown

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	H	M	S	H
CO2	S	M	S	M	H
CO3	S	S	S	S	S
CO4	H	M	H	H	M

S – Strong **H** – High **M** – Medium **L** – Low

PBT59

Non-Major Elective

Programme code: 08	Programme title: M.Sc. Biotechnology		
Non-Major Elective – Food Technology			
Batch 2019-2020	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To study the primary source of microbes in various foods,
2. To know the definition, general features and different products.
3. To understand the existence of microbes on foods and foodborne diseases.

Course Outcomes (CO)

K1	CO1	Introducing the students to the fundamentals of food science and technology
K2	CO2	Interpreting the role of carbohydrates and enzymes in food sciences.
K3	CO3	Identifying the foodborne diseases and causative agents with their social impacts.
K4	CO4	Understanding of the advanced principles of food processing and how to choose a method of preservation in relation to food composition

Syllabus

UNIT I (15 Hours)

Carbohydrates: Structure and functional properties of mono-oligo-polysaccharides including starch, cellulose, pectic substances and dietary fibre; Proteins: Classification and structure of proteins in food; Lipids: Classification and structure of lipids, Rancidity of fats, Polymerization and polymorphism; Pigments: Carotenoids, chlorophylls, anthocyanins, tannins and myoglobin; Food flavours: Terpenes, esters, ketones and quinones.

UNIT II (15 Hours)

Enzymes: Specificity, Kinetics and inhibition, Coenzymes, Enzymatic and non-enzymatic browning; Nutrition: Balanced diet, Essential amino acids and fatty acids, PER, Water soluble and fat soluble vitamins, Role of minerals in nutrition, Antinutrients, Nutrition deficiency diseases.

UNIT III (15 Hours)

Characteristics of microorganisms: Morphology, structure and detection of bacteria, yeast and mold in food, Spores and vegetative cells; Microbial growth in food: Intrinsic and extrinsic factors,

Non-Major Elective

Growth and death kinetics, serial dilution method for quantification; Food spoilage: Contributing factors, Spoilage bacteria, Microbial spoilage of milk and milk products, meat and meat products.

UNIT IV (15 Hours)

Foodborne disease: Toxins produced by Staphylococcus, Clostridium and Aspergillus; Bacterial pathogens: Salmonella, Bacillus, Listeria, Escherichia coli, Shigella, Campylobacter; Fermented food: Buttermilk, yoghurt, cheese, sausage, alcoholic beverage, vinegar, **sauerkraut*** and soya sauce. Prebiotics and Probiotics.

UNIT V (15 Hours)

Food processing principles**: Canning***, chilling, freezing, dehydration, control of water activity, CA and MA storage, fermentation, hurdle technology, addition of preservatives and food additives, Food packaging, cleaning in place and food laws. Production concept in dairy industries, Solvent extraction, refining and hydrogenation of oil, processing principles in fruits vegetables and plantation products: Extraction, clarification concentration and packaging

** denotes Self study*

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

References

1. Foods: Facts and Principles – N. Shakuntalamanay M ShadaksharaSwamy
2. Food Science - B Srilakshmi
3. Food science, Chemistry and Experimental Foods - M Swaminathan
4. Text Book on Foods Storage and Preservation - Vijayakhader

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	H	M	S	H
CO2	S	M	M	M	H
CO3	M	S	S	S	S
CO4	H	S	H	H	S

S – Strong **H** – High **M** – Medium **L** – Low

PBT61

Non-Major Elective

Programme code: 08	Programme title: M.Sc. Biotechnology		
Non- Major Elective – Cancer biology			
Batch 2019-2020	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To make students learn the basics of cancer biology
2. To make the students understand the molecular genetics of cancer
3. To provide knowledge on diagnosis and treatment of cancer.

Course Outcomes (CO)

K1	CO1	Students are practiced to remember the specific terminologies by repeated discussions
K2	CO2	Students are explained wit neat diagrams to understand the molecular mechanism of cancer
K3	CO3	Students are trained to apply their new ideas in the field of cancer therapy
K4	CO4	Students are triggered to assume and analyze the results and interpret

Syllabus

UNIT I (15 Hours)

Introduction to Cancer: Cancer: Definition; Cancer incidence and mortality; Origin of neoplastic cells; Cancer as cellular disease; Types of Cancer: Benign Tumors Vs. Malignant Tumors, Common Symptoms, Causes of Cancer: Chemical Carcinogenesis; Irradiation Carcinogenesis; Oxygen Free Radicals, Aging and Cancer; Genetic Susceptibility and Cancer; Multiple Mutations in Cancer; DNA repair defects and their relationship to cancer; Viral Carcinogenesis.

UNIT II (15 Hours)

Cell Cycle Regulation and Cell Signaling in Cancer: Growth Characteristics of Malignant Cells; Cell Cycle Regulation; Evasion of Apoptosis (Programmed Cell Death); Growth Factors; Signal Transduction Mechanisms-G protein linked receptors, The phosphoinositide 3-kinase pathway, mTOR, Tyrosine kinase pathways, JAK-STAT pathway, Estrogen receptor pathway, Hypoxia-inducible factor, Tumor necrosis factor receptor signaling, Tumor growth factor-β signal transduction, Heat shock protein mediated events; Angiogenesis; Invasion and Metastasis; Biology of Tumor Metastasis.

Non-Major Elective

UNIT III (15 Hours)

Molecular Genetics of Cancer: Molecular Basis of Cancer-DNA Methylation and Cancer; Loss of Heterozygosity; Telomeres and Telomerase; Molecular Genetic Alterations in Cancer Cells - Translocations and Inversions, Chromosomal Deletions, Gene Amplification, Point Mutations, Aneuploidy, Disomy, Trinucleotide Expansion, Microsatellite Instability, Mismatch DNA Repair Defects, Gene Derepression in Cancer Cells, Oncogenes, Tumor Suppressor Genes: pRb and p53, DNA Tumor Viruses - V40 and Polyoma, Papilloma Viruses E6 and E7, Adenoviruses E1A and E1B, Hepatitis B Virus and Herpes Viruses.

UNIT IV (15 Hours)

Tumor Immunology: Mechanisms of the Immune Response to Cancer: Antigen Presenting Cells; Antigen Processing; T Lymphocytes and T Cell Activation; The Immunological Synapse; B Lymphocytes and B Cell Activation; Natural Killer Cells; Cell-Mediated Cytotoxicity; Role of Gene Rearrangement in the Tumor Response; Heat Shock Proteins as Regulators of the Immune Response; Inflammation and Cancer; Immunotherapy

UNIT V (15 Hours)

Cancer Diagnosis and Treatment: Tumor Markers; Gene Expression Microarrays; Proteomic Methods; Circulating Epithelial Cells; Circulating Endothelial Cells and Endothelial Progenitor Cells; Molecular Imaging; Haplotype Mapping. Molecular Mechanisms of Aging and cancer: Somatic Mutation; Telomere Loss; Mitochondrial Damage; Formation of Oxygen-Free Radicals; Cell Senescence; DNA Repair and Genome Stability; Caloric Restriction. Diet and Cancer Prevention; Chemoprevention; Antiproliferative Agents; Antioxidants; Protease Inhibitors; Histone Deacetylase Inhibitors; Statins; Multiagent chemoprevention

** denotes Self study*

Text books

1. Cancer Biology, Raymond W. Ruddon, 2007, 4th edition, Oxford University Press
2. Molecular Biology of Cancer by F. Macdonald, C.H.J. Ford, and A.G. Casson; Garland Science / Bios Scientific Publishers
3. The Biology of Cancer, Weinberg. Robert A, 2007, New York: Garland Science.
4. Molecular Biology of Human Cancers by Wolfgang Arthur Schulz Springer.
5. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics 2nd Ed. by Lauren Pecorino. Oxford University Press

PBT63

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	S	M
CO2	H	M	M	M	S
CO3	S	S	S	S	M
CO4	S	H	S	H	H

1. **S** – Strong **H** – High **M** – Medium **L** – Low

19PBT0J1

Programme code: 08	Programme title: M.Sc. Biotechnology		
Course code : 19PBT0J1	JOC 1 - Plant tissue culture and Organic farming		
Batch 2019-2020	Hours / Week 2	Total Hours 30	Credits 2

Course Objectives

1. To make students understand the applications of plant tissue culture
2. To give a detailed idea about the instruments used in plant tissue culture
3. To provide ideas on easy and low cost preparations of biomanures and biocontrol agents

Course Outcomes (CO)

K1	CO1	Students are remembered with names the scientific names by spell repeatedly
K2	CO2	Outline the concepts by summarize to easy understanding
K3	CO3	Students trained to choose the correct method and solve the problem by applying the specific techniques
K4	CO4	Students made in to distinguish even small variations by simple analysis

Syllabus

UNIT I

Introduction to plant tissue culture: Brief history, Principle and Significance of tissue culture, Design and Layout for wash area, Media preparation, Sterilization, Storage room, Transfer area for aseptic manipulations, Culture rooms and Observation/data collection areas.

UNIT II

Instrumentation in plant tissue culture: Laminar air flow chamber, Autoclave, Distillation unit, pH meter, Orbital shaker, Microscope, Deep freezer and Growth chamber - working principle and maintenance.

UNIT III

Types of media and cultures: Introduction, Types of media and its importance, Nodal culture, Callus culture, Cell culture, Embryo culture, Haploid culture, Protoplast isolation and culture, Somatic embryogenesis and synthetic seed preparation, Rooting and Hardening.

19PBT0J1

UNIT IV

Organic farming and manures: Organic farming; definition, relevance, biological nutrient management, Organic manures; Vermicompost, **Green manure***, Organic residue, Biofertilizer Soil amendments.

UNIT V

Integrated pest and weed management: Integrated pest and Weed management; use of biocontrol agents, bio pesticides etc. Organic certification in brief. Integrated farming system: Definition, Goal, Components, Factors affecting ecological balance, **Land degradation***, Soil health management.

** denotes Self study*

Text Books

1. Kalyan Kumar De. 2004. An Introduction to Plant Tissue Culture.2008. New Central Book Agency, Kolkata.
2. Dubey, R.C., 2013. A text book of Biotechnology (Revised Edition), S. Chand & Company Ltd. New Delhi.
3. Palaniappan SP &Anandurai K. 1999. Organic Farming–Theory and Practice. Scientific Publishers, Jodhpur
4. Joshi, M. 2014. New Vistas of Organic Farming 2nd Ed. Scientific Publishers, Jodhpur.

Reference Books

1. Chawla, H. S. 2002. Introduction to Plant Biotechnology. 2nd Edition, Science Publishers, Inc., Enfield, NH, USA.
2. Razdan, M. K., 2003. Introduction to Plant Tissue Culture. 2nd Edition, Science Publishers, Inc., Enfield, NH, USA.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	H	H
CO2	H	H	H	H	S
CO3	S	H	H	H	H
CO4	H	H	H	H	H

S – Strong **H** – High **M** – Medium **L** – Low

19PBT0J2

Programme code: 08	Programme title: M. Sc. Biotechnology		
Course code : 19PBT0J2	JOC 2 - Herbal Biotechnology		
Batch 2019-2020	Hours / Week 2	Total Hours 30	Credits 2

Course Objectives

1. To enable the students to learn about the biochemical parameters used in the in the identification and utilization of medical plants
2. To enable the students to learn about the extraction of phytochemicals and to procedures
3. To exploit and explore the medicinal values of plants

Course Outcomes (CO)

K1	CO1	The students recall the biosynthesis of primary and secondary metabolites involved in plants
K2	CO2	The students understand the concept of phyto-chemical extraction and principles involved in DNA and chemical fingerprinting techniques
K3	CO3	The students also know about applications of phyto-constituents in development of drug
K4	CO4	The students can able to validate the results obtained using the techniques involved in photochemical analysis

Syllabus

UNIT I

Phytochemistry: Biosynthesis of primary and secondary metabolites, Classification and metabolisms of alkaloids, terpenoids, carotenoids, flavonoids, tannins and phenolic acids.

UNIT II

General extraction isolation and purification techniques for alkaloids, terpenoids, carotenoids, flavonoids, tannins and other phenolic compounds from plants.

UNIT III

Biotechnology of medicinal plants: Suspension cultures, Production of secondary metabolites from cultured plant cells, elicitation, immobilization and biotransformation. Bioreactors.

19PBT0J2

UNIT IV

Bioactive studies: DNA fingerprinting of medicinal plants–DNA isolation and fingerprinting techniques. Chemical fingerprinting – GC, HPTLC and HPLC**.**

UNIT V

Anticancer, antidiabetic, anti-inflammatory, hepatoprotectives, antimicrobials from medicinal plants. Antioxidants of plant origin – phenolics, terpenoids and alkaloids. Toxicity studies on medicinal plants and herbal formulations.

Teaching Methods

Powerpoint presentation/ Google Class rooms/Seminar/Quiz/Discussion/Assignment/ Demonstration

References

1. Harborne, J.B., 1998. Phytochemical methods to modern techniques of plant analysis. Chapman & Hall, London.
2. Trease G. E, M. C. Evans, 1979. Textbook of Pharmacognosy12th ed. Balliere-Tindal, London.
3. Irfan A. Khan and AtityaKhanum (Eds.). 2004. Role of Biotechnology in medicinal and Aromatic plants, Vols. I-X. Ukaaz Publications, Hyderabad.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	S	H	S	M
CO2	H	S	M	M	M
CO3	M	H	M	S	S
CO4	M	H	M	S	S

S – Strong **H** – High **M** – Medium **L** – Low

19PBT0D1

Programme code: 08	Programme title: M. Sc. Biotechnology
Course code : 19PBT0D1	ALC. 1 – Frontier Technologies in Biosciences
Batch 2019-2020	Credits 2

UNIT I

Stem cell technology: Stem cell, definitions, types and properties. Scientific terms, factors governing manipulations and culturing of stem cells. Micro-environmental factors governing stem cell propagation. Applications: Tissue engineering, reprogramming of genome function through epigenic inheritance. Ethical and social considerations of stem cell technology.

UNIT II

Neurobiology: Chemistry, synthesis, storage and release of neurotransmitters. Classes and mode of action of neuropeptides. Neuropeptide receptors, coexistence of neuropeptides with other neurotransmitters in "Dorsomedial Hypothalamic Nucleus". Neurodegenerative Disorders: Parkinson's, Alzheimer's disease, amyotrophic lateral sclerosis, senile dementia.

UNIT III

Nanobiotechnology: Definitions and terms, molecular motors, DNA hybridization control using metal ion crystal antennae. DNA-Based Nanofabrication. Self-Assembling DNA Tilings as Structural Templates, Molecular Electronics Microarray chips:- Microarray probes / chips, array fabrication, targets, assays, read out, image analysis, uses and examples.

UNIT IV

Diagnostic Techniques: Immunoassay Classification and Commercial Technologies, assay development. Cell Based and DNA based diagnostics. Functional Proteomics: Proteome, Mass spectroscopy of various protein complexes, Organization of proteome in an organism and its systematic study, Protein chips and Computation.

UNIT V

Biosensors: Concepts and applications, Noninvasive Biosensors in Clinical Analysis, Surface Plasmon Resonance, Biosensors based on Evanescent Waves, Applications of Biosensor-based instruments to the bioprocess industry, Application of Biosensors to environmental samples, Biochips and their application in modern Sciences.

19PBT0D1

Textbook

Biotechnology. U. Satyanarayana. Books and Allied (P) Ltd. August 2007.

References

1. The Science of Laboratory Diagnosis, J. Crocker and D. Burnett 2nd Edition. John Wiley Publishers. 2005.
2. Nanotechnology: A Gentle Introduction to the Next Big Idea, M. Ratner and D. Ratner. Prentice Hall. 2002
3. Text book of Medical Physiology, A.C. Guyton & J.E. Hall. 10th Edition. Harcourt, Asia. 2001.
4. Principles of Cell Biology. G. Ramsay.1998. Commercial Biosensors. John Wiley and Son, Inc. K. Smith and M. Kish. Harper-Cellins Pub. Inc. New Delhi.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	H	H
CO2	H	H	H	H	S
CO3	S	S	S	M	H
CO4	H	H	H	H	M

S – Strong **H** – High **M** – Medium **L** – Low

19PBT0D2

Programme code: 08	Programme title: M. Sc. Biotechnology
Course code : 19PBT0D2	ALC. 2 – Stem Cell Technology
Batch 2019-2020	Credits 2

Course Objectives

1. To make students understand the basics of stem cells
2. To give a detailed idea about the application of stem cells
3. To provide ideas on the technologies implied in stem cell culturing and application

Course Outcomes (CO)

K1	CO1	Students remember the scientific terms by repeated learning
K2	CO2	Students understand the concepts with help of videos displayed during class hours
K3	CO3	Students are trained to choose the correct method and solve the problem by applying the specific techniques
K4	CO4	Students are trained to distinguish even small variations by simple analysis

Syllabus

UNIT I

Cell Diversification and responses in the early animal embryo: *Xenopus* - Blastomeres and Spatial Segregation, inductive interactions, progressive pattern of new cell types generation. Morphogen gradient organization of complex pattern of cell responses, cell signal response, intracellular signals, early mammalian embryo and developmental potential, responses of mammalian embryonic stem cells to environmental stress and their pathway of development.

UNIT II

Renewal by stem cells: Stem cells division, epidermis and differentiated progeny, various keratins synthesis during stem cell development, basal cells, basal cell proliferation and thickness. Epidermal stem cells, secretory cells in the epidermis and population kinetics.

UNIT III

Specialized cells and their functions. Genesis, modulation, and regeneration of skeletal muscle: myoblasts fusion, muscle cells properties and protein isoforms, quiescent stem cells in the adult.

19PBT0D2

UNIT IV

Fibroblasts and their transformations: the connective-tissue cell family fibroblasts response to signals in the extracellular matrix, connective-tissue cell differentiation, fact cells signaling and production, bone remodeling, osteoblasts and bone matrix, osteoclasts and their ole to connective-tissue framework and body structure.

UNIT V

Hematopoietic stem cell: Types and functions. Hematopoietic stem cell disorders-classification and manifestations of aplastic, myelodysplastic, myeloproliplastic disorders. Clinical applications of colony stems. Complications of germline therapy, replacement therapy and marrow transplantation. Immunological principles, preservation and clinical use of blood and blood components, hemapheresis procedures and oxiplantation.

Textbook

Gilbert. S.F. 2000Developmental Biology. 6th Edition. Sinauer Associates, Inc. NY.

References

1. Kiessling A.A. and C.S. Anderson, 2003. Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential. Amazon Publishers.
2. Alberts, B., 2002. Molecular Biology of the Cell. 4th Edition. Garland Publishing, Inc., NY.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	H	H
CO2	H	H	H	H	S
CO3	S	H	H	H	H
CO4	H	H	H	H	H

S – Strong **H** – High **M** – Medium **L** – Low

PBT72

QUESTION PAPER PATTERN FOR CIA & END OF SEMSTER EXAMINATION

M. Sc., BIOTECHNOLOGY

1. THEORY Max Marks = 75

Time = 3.00 hrs

SECTION - A (10 x 1=10 marks)

Choose the correct answer type.

Q.No. 1 to 10: Multiple choice type ***alone.***

Questions with four alternative (distracter) answers each (Two questions from each unit).

SECTION - B (5 x 5=25 marks)

Short answer questions

Q.No. 11-15: Either (a) or (b) short note type (One question 'a' or 'b' from each unit)

SECTION - C (5 x 8=40 marks)

Essay type of questions:

Q.No. 16-20: Either (a) or (b) essay type (One question 'a' or 'b' from each unit)

2. BREAK UP OF INTERNAL MARKS (25 marks)

Internal marks (25) = CIA (out of 15**) + Attendance (**out of 5**) + Assignment/ Demonstration (**out of 5**)**

***CIA marks (out of 15 marks) = I CIA marks + II CIA marks / 150 X 15**

3. PRACTICALS – Question Pattern & Break-up of marks

PBT73

END OF SEMESTER PRACTICAL EXAMINATION

Max. Marks: 60
Duration: 3hrs

I. Major (One question) (1 x 20 = 20)

II. Minor (One question) (1 x 10 = 10)

III. Spotters (3 x 5 = 15)

Examine, identify and critically comment on the spotters A, B, C, D and E.

IV. Viva (05)

V. Record / Observation* (10)

**Record for ESE; Observation for CIA exam.*

INTERNAL - PRACTICAL MARKS

From Model Practical Examination	-	25
Observation	-	10
Attendance	-	5
Total	-	40

PBT74

QUESTION PAPER PATTERN FOR JOC AND ALC SUBJECTS EXAMINATION

THEORY Max Marks = 100

Time = 3.00 hrs

SECTION - A (10 x 10=100 marks)

Essay type of questions:

Q.No. 1-10: Either (a) or (b) essay type (Two questions 'a' and 'b' from each unit)